

ASKAR'YAN, G.A.

Decrease of the penetrating power of intense light due to scattering by refracting halos caused by the optical disturbance of the medium near inhomogeneities. Zhur. eksp. i teor. fiz. 45 no.3:810-812 S '63. (MIRA 16:10)

1. Fizicheskiy institut imeni P.N. Lebedeva AN SSSR.  
(Light--Scattering) (Light--Transmission)

ACCESSION NR: AP4012574

S/0056/64/046/001/0403/0405

AUTHOR: Askar'yan, G. A.

TITLE: Excitation and dissociation of molecules in an intense light field

SOURCE: Zhurnal eksper. i teoret. fiz., v. 46, no. 1, 1964, 403-405

TOPIC TAGS molecule dissociation, intense light, intense modulated light, excitation probability, homopolar molecule, heteropolar molecule, homopolar molecule dissociation, heteropolar molecule dissociation, heating of molecule, resonance interaction, nonresonance interaction

ABSTRACT: The possibility of and conditions for efficient direct dissociation of molecules in a very intense light field is indicated, and the magnitude of the effect is estimated by means of simple quasiclassical calculations. In the case of homopolar molecules it

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ACCESSION NR: AP4012574

is shown that for an atomic mass  $\approx 10^{-24}$  g, a natural vibration frequency  $\approx 10^{15}$  sec<sup>-1</sup>, and a field of  $10^7$  V/cm the molecule breaks up within  $\approx 10^{-10}$  sec at resonance (when the external pulsation frequency approaches the natural frequency). The differences between non-resonance and resonance interaction are examined as functions of the mutual positions of the interacting atoms and the direction of the electric vector of the light wave. The dissociation of heteropolar molecules, under similar conditions, should be more intense. It follows from the analysis that an intense light field with resonance carrier or modulation frequencies can be used for effective excitation and dissociation of molecules. Possible applications are intensification of the effect of light on molecular media or on micro-objects, dissociation of fast atoms or ions entering a trap, production of an atomic beam from a molecular beam, direct heating of molecules of a medium, etc. Orig. art. has: 5 formulas.

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ACCESSION NR: AP4012574

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR (Physics Institute, AN SSSR)

SUBMITTED: 16Nov63

DATE ACQ: 26Feb64

ENCL: 00

SUB CODE: PH

NO REF SOV: 002

OTHER: 000

Card 3/3

ACCESSION NR: AF4019255

001/0814/0816

AUTHORS: Askar'yan, G. A.; Delone, G. M.; Krokhin, N. S.

TITLE: Action of intense light on ions in a magnetic trap

SOURCE: Zhurnal eksper. i teor. fiz. 1964, 814-816

TOPIC TAGS: plasma, magnetic trap, ionization, ionization by light flash, trap, confinement, ion dissociation, molecule dissociation, neutral atom ionization

ABSTRACT: The paper evaluates the efficiency of filling magnetic traps with fast ions produced by ionization of solid matter by a powerful flash of light in a magnetic field and (2) the action of intense light on beams of fast particles entering the trap. A method proposed by N. G. Basov and O. N. Krokhin is shown

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ACCESSION NR: AP4019255

(ZhETF, v. 46, 171, 1964) to heat the ions through electron collisions in a focused beam of coherent light has low efficiency and that it is better to have the ions produced by the light directly, and not through the intermediary of the electrons. The resultant ion energy is estimated to be approximately 10 times thermal, and in view of the small initial dimensions of the heated region the plasma can be confined by means of a pulsed magnetic field. The second method is based on a recently established fact that a focused beam of coherent light exerts a strong ionizing action on a rarefied gas (E. Damon and R. Tomlinson, Applied Optics, v. 2, 546, 1963; F. V. Bunkin and A. M. Prokhorov, ZhETF, v. 46, 1090, 1964). The fact that the ionization probability increases exponentially with the power of the light ( $W \sim e^{BP}$ , where  $B = \sim 3 \times 10^{-2} \text{ kW}^{-1}$ ) favors effective ionization of even fast particles. It is shown that the strong electric field of the coherent light can be used also to dissociate or ionize molecular ions in addition to ionizing neutral atoms following their entry into the trap. Further research is

ACCESSION NR: AP4019255

therefore urged, aimed at theoretical and experimental studies of ionization and dissociation of molecules and molecular ions in a strong light field. Orig. art. has: 1 formula.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR (Physics Institute, AN SSSR)

SUBMITTED: 20Nov63

DATE ACQ: 27Mar54

ENCL: 00

SUB CODE: PH

NO REF SOV: 004

OTHER: 001

Card 3/3

L 13220-65 BSD/SSD/AFWL/RAZM/ )/ESD( )/ESD(ss)/ESD(t)  
ACCESSION NR: AP4043663 5/0056/4/047/002/0782/0782

AUTHOR: Askar'yan, G. A.

TITLE: Second harmonic radiation from inhomogeneities in an intense light field B

SOURCE: Zh. eksper. i teor. fiz., v. 47, no. 6, 1964, 782

TOPIC TAGS: light scattering, light excitation, optical propagation, cloud chamber, bubble chamber, harmonic oscillation

ABSTRACT: The author considers the effects of radiation of waves of doubled frequency when small inhomogeneities of an isotropic medium are placed in an intense electromagnetic field with sinusoidal periodicity. These effects are connected with quadratic transverse polarization of the particles under the influence of the Lorentz force due to the interaction between the alternating dipole moment of the inhomogeneity and the magnetic field of the wave.

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L 1920-65

ACCESSION NR AP4043663

They are not connected with the nonlinear properties of the medium. The inhomogeneity is assumed to be much smaller than the wavelength. It is shown that the ratio of the intensity of the second-harmonic radiation to the intensity of the scattered light is independent of the size of the inhomogeneities, and if the number of the latter is large (fog, clouds, dust, droplets, bubbles in a liquid) then the second-harmonic radiation should be noticeable and readily distinguishable from the intense scattered light. This is especially easy if the fundamental is in the invisible infrared and the second harmonic is in the visible region. This phenomenon may be of use not only for the study of disperse media, but also to display inhomogeneities produced by an ionizing particle in a bubble or cloud chamber. I am grateful to Corr. Member A. M. Prokhorov and Prof. M. S. Rabinovich for useful discussions. Orig. art. has 3 formulas.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR (Physics Institute, AN SSSR)

Card 2/3



L 13920-65  
ACCESSION NR: AP4043663

SUBMITTED: 16Jun64

SUB CODE: OP

NO REF SOV: 000

INCL: 00

OTHER: 000

Card 3/3

1. 51299-65 EWT(1) IJP(o)

ACCESSION NR: AP5013664

UR/0386/65/001/001/0009/0015

AUTHOR: Askar'yan, G. A.; Rabinovich, M. B.; Saychenko, M. M.; Smirnova, A. D.

TITLE: Light spark in a magnetic field

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 1, no. 1, 1965, 9-15

TOPIC TAGS: laser, laser induced spark, laser air breakdown, laser induced plasma, controlled fusion reaction

ABSTRACT: The first results of experiments with a laser-induced spark in an external magnetic field are presented. The magnetic field made it possible to study the development of spark plasma based on magnetic induction signals, and to study the spark-field interaction as applied to plasma containment, acceleration, and injection into mirror machines. A Q-switched laser was used in the experiments. The most striking result of the experiments was the long duration of the diamagnetic plasma (of the order of several microseconds), which was bracketed by initiation and damping signal pulses on a baseline 5  $\mu$ sec long. The mechanism of formation of the prolonged magnetic moment is not

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L 51299-63

ACCESSION NR: A25013664

clear. However, the effect may be utilized in attempts to inject additional energy into the spark plasma by h-f external fields or by longer-pulse lasers with a higher energy input. Orig. art. has: 4 formulas and 1 figure. [SK]

ASSOCIATION: Fizicheskii Institut im. P. N. Lebedeva Akademi nauk SSSR (Physics Institute of the Academy of Sciences, SSSR)

SUBMITTED: 03Feb65

ENCL: 00

SUB CODE: EC, CM

NO REF: 006

OTHER: 003

ATD PRESS: 4014

Cont. 2/2

L 6:563-65 EWT(1)/EPT(n)-2/EOO(n) PA(w)-2 Pz-6/Pa-4/Ab-10/P1-1 IJP(c)  
 WW/TT  
 ACCESSION NR: AP5014240 UR/0386/65/001/003/0044/0049  
 AUTHOR: Sakar'yan, G. A.  
 TITLE: Acceleration of particles by the edge field of a moving plasma point that intensifies an electric field  
 SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Plasma v redaktsiyu. Prilozheniya, v. 1, no. 3, 1965, 44-45  
 TOPIC TAGS: particle acceleration, moving plasma, field effect, electric breakdown, discharge leader, plasma loop  
 ABSTRACT: Although quasi-static electric fields are incapable of accelerating particles to energies above the field potentials, the author shows that by means of a moving inhomogeneity, which intensifies a quasi-static electric field, it is possible under certain conditions to obtain acceleration equivalent to many times the actually employed potential difference. It is demonstrated that the edge intensification of the field by means of a point, a phenomenon dating back to the theories of the lightning arrester, of streamer propagation, etc., can be used effectively to accelerate particles or matter, provided the front of formation of propagation

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ACCESSION NR: AP5014240

of the peak of the inhomogeneity ("point") moves together with the accelerated particles. This can occur in those cases when the accelerated particles themselves constitute part of the inhomogeneity or produce it, or when the accelerated particles themselves initiate the creation of the inhomogeneities by the field itself. Three specific cases are considered in detail: 1. Acceleration of the particles themselves in the edge of the inhomogeneity, where the inhomogeneity itself can be produced by a thin plasma jet escaping from an electrode (plasma gun, spark source, laser beam focused on the electrode, etc.). 2. Acceleration in which the particles move from one of the electrodes, leaving behind it a plasma loop (for example, as a result of heating the particle with a laser beam or ionization of the residual air by fast motion of the particle). 3. Acceleration of particles in a breakdown leader. The quadratic dependence of the accelerating force on the field intensity in the first of the above two processes and the possibility of modification of the field of the point by the properties of the gas in the third variant, make it possible to make multiple use of alternating electrodes of one high-voltage source for through-acceleration. The acceleration mode is by its nature pulsed, since nonstationary processes are used. The described acceleration mechanism can arise when electric fields are used to draw out ions from a concentrated pulse-produced plasma. It is

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ACCESSION NR: AP5014240

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quite possible that this mechanism plays an essential role in the appearance of fast ions upon application of an electric field to a plasma of a hot vacuum spark. "I am grateful to Professor M. S. Rabinovich for a discussion and interest in the work." Orig. art. has: 4 formulas. [02]

ASSOCIATION: Fizicheskii institut Akademii nauk SSSR (Physics Institute, Academy of Sciences SSSR)

SUBMITTED: 03Apr65

ENCL: 00

SUB CODE: NP, ME

NO REF SOV: 003

OTHER: 000

ATD PRESS: 4020

dm  
Card 3/3

L 64 54-65 EHA(E)/FBD/EPG(P)/EWT(1)/EPF(c)/EEG(1)-2/EPH(w)-2/T/EEG(b)-2/  
 ACCESSION NR: AP5019591 EHA(E)/FBD/EPG(P)/EWT(1)/EPF(c)/EEG(1)-2/EPH(w)-2/T/EEG(b)-2/  
 SETH/IJP(c) WC UR/0386/65/001/006/0018/0023  
 AUTHOR: Askar'yan, G. A.; Rabinovich, M. B.; Savchenko, M. M.; Smirnova, A. D.  
 TITLE: Discovery of a fast photoionization halo and a cloud of concentrated long-lived ionization from a shock wave of a breakdown in the laser beam  
 SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Priklada'ya redaktsiya. Prilozheniye, v. 1, no. 6, 1965, 18-23  
 TOPIC TAGS: laser, breakdown, photoionization, ionization, plasma, laser beam, multiphoton absorption, gas breakdown  
 ABSTRACT: The results are presented of an experimental study of the ionization halo produced during breakdown of a gas by a laser beam in the region of the breakdown. The laser beam from a Q-switched laser with a rotating prism was focused between a horn equipped with a detector and an antenna of an 8-mc oscillator by means of a lens with a 5-cm focal length. This arrangement made it possible to make simultaneous measurements of the transmitted and reflected microwave radiation displayed on an oscilloscope. A comparison of the degree of attenuation of the microwaves determined from the change in the detector current and the current corresponding to the voltage at the time of the appearance of the breakdown shows that microwave radia-  
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L 64:34-65

ACCESSION NR: AP5019591

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tion is strongly dissipated in the plasma of the halo. The lifetime of the plasma in the halo is relatively long, reaching hundreds of  $\mu$ sec. The maximum attenuation occurs within a period less than 5  $\mu$ sec after the breakdown. The authors also observed an ionization halo caused by radiation from the region heated by the laser beam, where the radiation is propagated ahead of the shock wave. The attenuation and scattering by this halo should increase with the wavelength of the microwave radiation. The high degree of ionization and heating due to photoionization and the shock wave near the region of the breakdown result in a relatively long lifetime of the plasma. Orig. art. has 2 figures. [CS]

ASSOCIATION: Fizicheskii Institut im. P. N. Lebedeva Akademii nauk SSSR (Physics Institute, Academy of Sciences, SSSR)

SUBMITTED: 10 May 65

ENCL: 00

SUB CODE: OP

NO REF SOV: 002

OTHER: 002

ATD PRESS: 4065

Card 2/2



L 3933-66 ENT(1)/ETC/EFP(n)-2/ENG(m)/EPA(n)-2 IIR(c) AT  
ACC NR: AP5025257 SOURCE CODE: UR/0386/65/002/004/0179/0182

AUTHOR: Askar'yan, G. A. 44.55

ORG: Physics Institute im. P. N. Lebedev, Academy of Sciences, SSSR (Fizicheskii Institut Akademii nauk SSSR) 44.55 74B

TITLE: Self-acceleration of particles in an electric field of the polarized ionization trail

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 2, no. 4, 1965, 179-182

TOPIC TAGS: plasma, gas, particle acceleration, ionization, breakdown, gas breakdown, particle bunch 51.04.01

ABSTRACT: A theoretical analysis is made of the possibility of accelerating the particles passing through a medium by the edge field. The edge field is generated by the external field which polarizes the ionized trail left by the particles. Conditions for the acceleration of particles by the ionized trail are considered for the cases of the presence and the absence of breakdown. In the absence of breakdown and at a pressure of 1 atm, a frequency of interelectronic collisions  $2 \cdot 10^{11} \text{ sec}^{-1}$ , and with  $v/c \approx 1$ , the number of particles in the accelerated bunch required to achieve acceleration is  $N \approx 10^{12}$ . Thus, at least in principle, it is possible to accelerate particles by such a method without a breakdown increase in the density of ionization in the medium. In

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ACC NR: AP5025257

the presence of a breakdown, the number of particles in the accelerated bunch can be decreased by several orders of magnitude. The high-intensity edge fields ( $E > \text{Mev/cm}$ ) and the high velocity of the particles make it possible to neglect multiple scattering of particles along the path even at a pressure 21 atm. Since the edge field can be controlled within wide limits by selecting properties of the gas in separate sections, it is possible to accelerate the particle bunch by means of electrodes with alternating polarity fed from a common (relatively low-power) voltage supply. Orig. art. has: [CS]  
4 formulas.

SUB CODE: NP/ SUBM DATE: 21Jun65/ ORIG REF: 001/ OTH REF: 000/ ATD PRESS: 420

Cord 2/2

1 20619-66 FHD/ST(1)/EEC(k)-2/T/EWP(k)/EWA(h) IJP(a) WG  
ACC NR: KP6009/14 SOURCE CODE: UR/0386/66/003/004/0166/0170

AUTHOR: Askar'yan, G. A. 60  
13

ORG: Physics Institute im. P. N. Lebedev, Academy of Sciences SSSR  
(Fizicheskii institut)

TITLE: The thermo-optic effect in a laser beam 25

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 3, no. 4, 1966, 166-170

TOPIC TAGS: atomic interaction, thermo-optic effect, laser-induced cooling, cryogenics

ABSTRACT: A laser beam which, as a rule, causes heating and disorganization of atoms when incident on the surface of a material, can also be used in certain cases to cool transparent materials. This effect is associated with an intensified interaction of internal atoms in a quasi-homogeneous electromagnetic field. A mechanism is considered which explains changes in the kinetic energy of quasi-elastic atoms colliding in a homogeneous incremental electromagnetic field. Results indicate that the greater the number of molecules in a unit volume and the greater their polarizability, the greater the decrease in temperature. A discrete decrease in temperature of a material in a laser beam and an

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L 20619-66

ACC NR: AP6009714

increase in the interaction energy of its molecules may be manifested by the appearance of discrete quasi-crystalline structures, special molecule complexes, and a decrease in the speed of sound. Slow, repeated switching in and out of the laser field during that period of time which is shorter than the time between collisions, will intensify the cooling effect manifold. The temperature decrease jump and its applications are particularly interesting in cryogenics. Also of interest is the converse problem—a continuous increase in laser-induced temperature when a decrease in the molecular interaction increases the molecular kinetic energy. Under certain conditions, an intense hypersonic wave is generated in the laser beam which can lead to a periodic cooling and heating of a material. Thermo-optic effects at low temperatures can also occur at lower field intensities in non-focused laser beams. The passage of these through a material will result in a discrete or periodic stimulated freezing. [YK]

SUB CODE: 20/ SUBM DATE: 03Jan66/ ORIG REF: 001/ CTH REF: 002  
ATD PRESS: 4224

Cord 2/2 BK

L 1113-66 EWT(1)/ETC/EPT(n)-2/EPA(w)-2/EWT(D); IJP(c) AT		
ACCESSION NR: AP5021572		UR/0286/65/000/013/0045/0046 621.039.643
AUTHOR: Askar'yan, G. A.; Delone, N. B.; Rabinovich, M. S. 49,85 49,85 49,85 54 B		
TITLE: A method of filling magnetic traps with a <u>hot plasma</u> . Class 21, No. 172411 21, 97,85		
SOURCE: Byulleten' izobreteniy i tovarnykh znakov, no. 13, 1965, 45-46		
TOPIC TAGS: laser, plasma, magnetic trap		
ABSTRACT: The ionization and heating of a portion of matter in the focus of the laser takes place in the magnetic field of the trap formed by fast ions produced in gas-dynamic scattering of the plasma. By increasing the effectiveness of the interaction of ions accelerated by electron pressure, the effectiveness of the laser for obtaining the synthesis of high-temperature plasma is increased. [ZL]		
ASSOCIATION: none		
SUBMITTED: 26Sep63	ENCL: 00	SUB CODE: EM,EC
NO REF SOV: 000 Card 1/1 DP	OTHER: 000	ATD PRESS: 4088

G-25282-85 EWA(K)/EPI(L)/KPT(S)/KAO(X)-2/RPA(W)-2/EDC(U)/T/EI(L)(U)-2/BWP(K)/  
EWA(M)-2 PPI-L/PI-L/PI-L/PO-L/FR-L/PAB-10 IJP(S) JHB/WO/WI

ACCESSION NR: AP5004403

5/0056/65/048/701/0290/0291

AUTHOR: Askar'yan, G. A.; Rabinovich, M. S.

TITLE: Cascade ionization of a medium caused by an intense light flash

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 48, no. 1, 1965, 290-294

TOPIC TAGS: laser, gas ionization, laser induced ionization, laser induced gas breakdown, focused light ionization, plasma acceleration

ABSTRACT: A theory of laser-induced gas breakdown is considered for the case of electric field intensities of the light beam greater than  $10^7$  v/cm. The theory is based on the cascade ionization concept, in which the field intensities involved have a high probability of ionizing atoms previously excited up to the second or third levels. Sufficient density of excited atoms is provided by interaction with electrons which have absorbed laser light quanta of the order of magnitude of 1 ev. Thus, the energy of the excited atoms is directly expended on the cascade development, giving it a high initial rise rate. For example, given an electric field intensity of  $3 \cdot 10^7$  v/cm and an ionization potential of 10 ev, the cascade rise time will be  $3 \cdot 10^{-13}$  sec. The authors also consider the effect of an external magnetic field on the laser-induced spark in order to investigate the possibility of manipulation.

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L-25282-65

ACCESSION NR: AP5004403

lating the resulting plasma. The inductive signal from the magnetic interaction is derived as a function of conductivity, dimensions, and expansion rate of the laser-produced plasma. The small dimensions of the breakdown region allow for the application of high magnetic fields of the order of  $10^4$  G. The ionized material is directed towards the ionized material; these can in turn be utilized for various experiments, e.g., in controlled fusion reactions. Other effects of the cascade ionization process can lead to an enhanced absorption of high-intensity light and the generation of plasma trails in the path of intense light beams which can direct or reflect radio waves, light, sound waves, etc. (see also [1]).

ASSOCIATION: Fizicheskii Institut im. P. N. Lebedeva Akademii nauk SSSR (Physics Institute, Academy of Sciences, SSSR)

SUBMITTED: 10Jul64

ENCL: 00

SUB CODE: EC, ME

NO REF SOV: 004

OTHER: 002

ATTN PRESS: 3184

Cord 2/2

310552 ENG( )/ENR(k)/PBD/ENT(l)/EBC(k)-2/REC(k)/T/EEC(h)-2/EP(k)/INR(a)-2/ENR(h) Pn-4/Po-4/Pf-4/Pl-4/Pl-4/Peb IJP(c) GN/JHB  
 ACCESSION NR: AP5006516 570056/57048 001/0666/0672  
 AUTHOR: Askar'yan, G. A.

FIGURE 5. Strong excitation and dissociation of molecules in an intense laser field.

source. Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 48, no. 2, 1965, 656-672

TOPIC TAGS: dissociation, vibration, laser, laser field, coherent light, excitation, excitation probability, molecular physics, intense light

**ABSTRACT:** Excitation of vibrational degrees of freedom of molecules and their dissociation in an intense laser field of a laser are considered. A three-dimensional Morse oscillator model is used to calculate excitation and dissociation probabilities of a molecule. Various excitation channels, such as resonant absorption on the fundamental vibrational frequency (modulated light), nonresonant absorption, and direct transition across several levels, are considered. The analysis shows that numerous channels exist in which excitation and

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1 31079-64

ACCESSION NR: AP5006312

Dissociation of molecules can be accomplished by intense laser radiation. It is pointed out that resonant buildup of vibrations is possible at frequencies differing from those of incident radiation. Orig. art. has: 32 formulas. [CS]

ASSOCIATION: Fizicheskii institut im. P. N. Lebedeva /Akademii nauk SSSR (Physics Institute, Academy of Sciences, USSR)

SUBMITTED: 11 Aug 64

ENCL: 00

SUB CODE: NP/EC

REF ADV: 003

OTHER: 002

AD PRESS: 3198

Cord 2/3

ASKAR'YAN, G.A.

Coherent radio emission from cosmic-ray showers in the air and  
in dense media. Zhur. eksp. i teor. fiz. 48 no.3:988-990 Mr '65.  
(MIRA 18:6)

1. Fizicheskii institut imeni Lebedeva AN SSSR.

L 10958-66 EWT(1)/T/EWA(m)-2 ITP(c)

ACC NR: AP6002464

SOURCE CODE: 0386/65/002/011/0503/0506

AUTHOR: <sup>44,55</sup> Askar'yan, G. A.; <sup>44,55</sup> Rabinovich, M. S.; <sup>44,55</sup> Smirnova, A. D.; <sup>44,55</sup> Studenov, V. B. 94  
B

ORG: <sup>44,55</sup> Physics Institute im. P. N. Lebedev, Academy of Sciences, SSSR (Fizicheskii institut Akademii nauk SSSR)

TITLE: Polarization of the ionization halo during air breakdown in a constant electric field

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 2, no. 11, 1965, 503-506.

TOPIC TAGS: laser, nonlinear optics, laser pulsation, *gas ionization, electric field, laser beam*

ABSTRACT: <sup>21,44,55</sup> The ionization halo formed during gas breakdown at the focus of a beam from a Q-spoiled laser was investigated by studying its polarization due to an applied electric field,  $E_0 = 10 \text{ v/cm} - 1 \text{ kv/cm}$ , at the focus. In the first series of experiments, the quickly varying field perturbations generated during formation of the halo were registered by a thin probe with a dielectric sheath placed perpendicularly to the electric field at a distance of approximately 1 cm above the breakdown. The duration of a signal from the probe (30--50  $\mu\text{sec}$ ) was close to that of the laser pulse. Its amplitude  $E_m$  increased linearly with the increasing electric field ( $E_m/E_0 \approx 0.5 \times 10^{-3} \text{ cm}$ ). By comparing the signal from the probe with the characteristics of the halo, it was established that the region from which the field was forced out ( $a_{\text{eff}}$ ) was  $\sim 1 \text{ cm}$ . In the other series of experiments the

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ACC NR: AP6002464

breakdown occurred between two flat electrodes with a potential difference  $\Delta v$  placed relatively far away from each other. One of the electrodes was grounded through a 75-ohm resistor, and the current flowing toward the electrode was measured. It was confirmed that  $\alpha_{\text{eff}} \approx 1$  cm. In the experiments it was established that the photoeffect of the spark formed during the breakdown and the photoelectric effect associated with the surfaces of the electrodes could be neglected. The ionization of the gas was attributed to the multiphoton absorption in the ultraviolet region of the spectrum or to absorption of kv x-ray photons emitted by the hot plasma in the breakdown region. The authors also discovered a rapidly generated intrinsic dipole moment of the spark, the direction of which is opposite to the light beam. This dipole moment is probably associated with light pressure or thermoelectric effects. Orig. art. has: 2 figures.

[CS]

SUB CODE: 20 /

SUBM DATE: 18Oct65/ ORIG REF: 001/ ATD PRSS: 4170

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L 45820-66 ENT(1)/ENT(m)/T/BWP(k)/E:P(t)/ETI JD

ACC NR: AP6031587

SOURCE CODE: UR/0386/66/004/004/0144/0147

AUTHOR: Askar'yan, G. A.

ORG: Physics Institute im. P. N. Lebedev, Academy of Sciences SSSR (Fizicheskii institut Akademii nauk SSSR)

TITLE: Self-focusing and focusing of ultrasound and hypersound

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 4, no. 4, 1966, 144-147

TOPIC TAGS: ultrasonic, <sup>wave</sup> propagation, hypersound propagation, self focusing, laser application, *sound propagation*

ABSTRACT: The author points out the possibility of self-focusing and focusing of hypersonic rays from lasers or other sources, and estimates the conditions for the appearance and possible consequences of these effects. These effects are based on non-linear processes that produce a differential in the properties of the medium inside and outside the sound ray, and are similar to self-focusing of electromagnetic rays in media. Two particular cases are considered: 1. focusing of sound ray by the "wake" of a light ray, which modifies the properties of the medium enough to change the propagation of the sound wave medium through which the light has passed (the so called "wake" of the light ray). In dense media (liquids, solids) the speed of sound usually decreases when energy is released in the medium producing a wake that serves as a waveguide for the sound. 2. Self-focusing produced by the sound ray itself at high

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ACC NR: AP6031587

intensities. The sound propagation conditions needed for self-focusing are discussed for both cases. Mention is made of other possible effects, such as focusing of the sound by non-stationary expansion waves from the lateral surface of the ray, producing a tubular zone of reduced temperature (relative to the center of the beam), which reflects the diverging subrays back into the ray. It is mentioned in conclusion that self-focusing and focusing of sound waves can be of interest in connection with the problem of destruction of solids in the focal regions, formation of cavitation in liquids, production of large concentrations of hypersonic and ultrasonic radiation, transport and directional transfer of their energy, etc. The author thanks I. L. Fabelinskiy for valuable discussions. [02]

SUB CODE: 20/ SUBM DATE: 08Jun66/ ORIG REF: 005/ OTH REF: 004/ ATD PRESS: 5083

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1. 45778-66

ACC NR:

AP6031986

EEC(k)-2/EWP(k)/EWT(1)/EWT(2)/T/EWP(e) IJP(c) WH/WI

SOURCE CODE: UR/0386/66/004/005/0177/0180

AUTHOR: Askar'yan, G. A.; Rabinovich, M. S.; Smirnova, A. D.; Stepanov, V. K.; Studenov, V. B.

ORG: Physics Institute im. P. N. Lebedev, Academy of Sciences, SSSR (Fizicheskiy institut Akademii nauk SSSR) 72  
B

TITLE: Excitation of signals in a negatively charged post of an antenna under the influence of an unfocused laser beam 25

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 4, no. 5, 1966, 177-180

TOPIC TAGS: laser application, shf antenna, electron emission

ABSTRACT: The authors describe the results of an investigation of current pulses produced when an unfocused laser beam strikes a metallic electrode or a post that serves as an antenna, on which a negative potential is applied. An ordinary Q-switched ruby laser was used, whose beam was aimed onto an antenna post located several meters away and under a negative voltage  $U \approx 0 - 3$  kev. The antenna post was connected to ground through a capacitor and a resistor. The pulse picked off the resistor was fed through a capacitor and amplifiers (UR-3 and UR-4) to an oscilloscope (SI-10). The pulse induced in the antenna was commensurate in length with the duration of the laser flash. The pulse amplitude was at first approximately proportional to the voltage applied to the antenna but at a voltage  $\geq 1$  kv the magnitude of the signal increased sharply with

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L 45778-66

ACC NR: AP6031986

increasing voltage. No noticeable signals were registered at zero and positive potentials. The mechanism of the observed pulses is shown to be connected with the current produced when the electrons knocked out by the laser radiation are removed from the post. The production of free electrons may be connected with the photoeffect from the oxidized surface (if the surface is clean, the laser quantum energy is insufficient to produce the photoeffect), with the heating of the electrons on the surface of the metal upon absorption of the laser light, with a burst of photoelectric field emission, or with a cascade. If the role of the light were to consist of facilitating the cold emission under the influence of the field, or if cascade multiplication of the electrons in the gas at the post were to take place, then the dependence of the current on the voltage should be much stronger. It is possible that some of the foregoing processes are responsible for the intensification of this dependence at sufficiently large field intensities. When the gas pressure around the antenna decreases, the electron mobility increases and the voltage needed to remove the electrons can be small. The described effect can be used for remote excitation of receiving and transmitting antennas with the aid of a guided laser beam, to register and measure laser radiation power, etc. Orig. art. has: 2 figures and 1 formula. [02]

SUB CODE: 20, 09/ SUBM DATE: 16 Jun 66 / ATD PRESS: 5084

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L 26072-66 EWP(j)/EWI(1)/ENT(m)/ETC(m)-6/T RM/DS/VW/JW

ACC NR: AP6015804

SOURCE CODE: UR/0386/56/003/010/0404/0407

AUTHOR: Askar'yan, G. A.; Gol'ts, E. Ya.; Rabinovich, M. S.; Studenov, V. B. 96  
91

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TITLE: Electric breakdown through a flame

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pism'a v redaktsiyu.  
Prilozheniye, v. 3, no. 10, 1966, 404-407

TOPIC TAGS: electric discharge, dielectric breakdown, flame, discharge plasma,  
exploding wire

ABSTRACT: To investigate electric breakdown through a flame with an aim at obtaining data of value to gas-discharge physics, shock-wave production under laboratory conditions, and for production of intense flashes, cumulative collapses, pinches, etc. at atmospheric pressures without surrounding the discharge with chamber walls, the authors discharged a bank of five capacitors of 150  $\mu$ F each, charged to 5--10 kv, through a vacuum discharge gap into a flame plasma. The discharge development was recorded by a high-speed camera (SFR). The flash of light was recorded with a photomultiplier and its energy measured with a special calorimeter. The current flowing through the plasma was measured with a Rogowski loop and reached several hundred ka. A vertical flame jet was produced by a burner using a mixture of illuminating gas and oxygen. The temperature of such a flame usually does not exceed 2000°. One electrode was the body of the burner, and the other was a high-melting-point metal rod. The

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ACC NR: AP6015804

experiment has shown that the initial breakdown voltage in the plasma is close to 1 kv/cm, which is several dozen times smaller than the breakdown voltage under normal conditions. A flame jet 10 cm long broke down regularly at 10 kv, and the flame was not extinguished after the breakdown. The duration of the intense glow was ~150  $\mu$ sec. Comparison of the signals from the photomultiplier used to record the glow from the discharge plasma with the current through the discharge shows that the buildup and glow times are commensurate with the growth and duration of the discharge currents. From this and from comparison of the optical radiation with the flash energy produced by discharging the same capacitor bank through an exploding wire it is concluded that the essential stage for the radiation in the given section of the spectrum is not the initial one, but the subsequent development of the discharge, in view of the long duration of the process of discharging the capacitor bank. The use of a flame from one or several burners, besides facilitating the breakdown of long gaps, makes it possible to increase further the linear dimensions of the breakdown path without resorting to the inconvenient frequent replacement of contacts (foils and wires) required in other methods. Discharge through a flame is also of practical interest for intensification of chemical reactions in flames, for physics of atmospheric phenomena, and other effects. The authors thank V. P. Solov'yev, B. P. Shurukhin, and A. V. Chirkov for help in creating the installation. Orig. art. has: 2 figures. [02]

SUB CODE: 20/

SUBM DATE: 22Mar66/

OTH REF: 002/ ATD PRESS: 4252

Card 2/2 CL

L 30389-66 EEC(k)-2/EWP(k)/EWT(1)/FBL/T IJP(c) WG

ACC NR: AP6020790

SOURCE CODE: UR/0386/65/003/012/0465/0468

AUTHOR: Askar'yan, G. A.; Rabinovich, M. S.; Savchenko, M. M.; Stepanov, V. K. 96

ORG: Physics Institute im. P. N. Lebedev, Academy of Sciences, SSSR (Fizicheskii Institut Akademii nauk SSSR) 93

TITLE: Fast overlap of microwave radiation by an ionization aureole of a spark in a laser beam

SOURCE: <sup>25</sup> Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye v. 3, no. 12, 1966, 465-468

TOPIC TAGS: gas ionization, ionization phenomenon, ionized plasma, microwave plasma, *SPARK SHOCK WAVE, LASER BEAM*

ABSTRACT: This is a continuation of earlier investigations (Pis'ma ZhETF v. 1, no. 6, 18, 1965) of the ionization aureole behind the shock wave of a light spark in a laser beam. The present study deals with shorter times (tens and hundreds of nanoseconds), when the ionization leads the shock wave from the spark. The spark from a Q-switched laser beam was flashed in front of a radiating antenna fed from an 8-mm magnetron. The receiving antenna was placed either behind the spark (in aureole overlap investigations) or at different angles (in reflection investigations). The area of the microwave radiation overlap by the aureole was

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determined by comparing the overlap signal at different distances from the spark to the antenna axis and found to have a radius of 1.5 - 2 cm. The values of the reflection signals at different large angles, including back reflection, were commensurate with the overlap signal. This shows that the scattered radiation is due not only to the absorption diffraction, but also to the high reflectivity of the aureole plasma. The electron density in the latter is estimated to be  $\sim 10^{13} \text{ cm}^{-3}$ , which is two orders of magnitude higher than the intensity obtained by the authors from polarization measurements (Pis'ma ZhETF v. 2, 503, 1965). The sparks and ionization aureoles differed for different gases (air, oxygen, argon, nitrogen, helium, hydrogen). The high speed of the strong overlap of radiation by the fast aureole after a time  $\sim 10 \text{ nsec}$ , and the large overlap area, suggest that the fast aureole may be useful for sharp overlap, modulation, or diversion of microwave beams. The authors thank D. K. Akulina and A. D. Smirnova for valuable advice, and L. Kolomeytsev for help with the work. Orig. art. has: 2 figures. [02]

SUB CODE: 20/ SUBM DATE: 04Apr66/ ORIG REF: 002 / ATD PRESS: 5017

Card 2/2 CC

ACC NR: AP7000536

SOURCE CODE: UR/0386/66/004/010/0400/0403

AUTHOR: Askar'yan, G. A.

ORG: Physics Institute im. P. N. Lebedev, Academy of Sciences SSSR (Fizicheskii institut Akademii nauk SSSR)

TITLE: Self-focusing of a light beam upon excitation of the atoms and molecules of the medium in the beam

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 4, no. 10, 1966, 400-403

TOPIC TAGS: excited state, light excitation, laser beam, laser r and d, self focusing

ABSTRACT: The author points out that the vibrational, rotational, and electronic excitation of the molecules and atoms of a medium in which a powerful light beam passes, and disintegration of their associations under the influence of the light beam or processes accompanying it, can contribute to the self-focusing of the beam. The excitation of the atom or molecule makes its electronic structure more friable and increases the polarizability. For example, electronic excitation of a very simple atom to the  $n$ -th level increases its dimensions by  $n^2$  times and its polarizability by  $n^6$  times, so that the polarizability can increase by a factor  $\sim 10^2 - 10^3$  even when  $n = 2 - 3$ , and still more in the case of resonance levels. When rotational or vibrational motions are excited in the molecule, the increase in its optical polarizability is smaller, but this can result in a noticeable change in the dielectric constant

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because more molecules are excited in this manner. These processes do not necessarily call for the medium to be heated. Approximate equations are presented for the dynamics of the variation of the optical penetrability of the medium, and the conditions under which heating can be neglected are estimated. It is noted that the molecules and atoms can be excited or dissociated not only under the influence of the light itself, but also by light-induced processes such as many-photon ionization. The time lag of self-focusing due to excitation is shown to be shorter than that due to focusing by striction, thermal expansion, and other processes. The author thanks Yu. P. Rayzer for a discussion. Orig. art. has: 3 formulas.

SUB CODE: 20/ SUBM DATE: 16Aug66/ ORIG REF: 006/ OTH REF: 001  
ATD PRESS: 5107

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02956-27 EM(1)/BEC(R)-2/7/EWE(R) 13F(c) AG/AT  
ACC NR: AT6033038

SOURCE CODE: UR/2504/66/032/000/0089/0096

AUTHOR: Askar'yan, G. A.; Rabinovich, M. S.

ORG: Physics Institute im. P. N. Lebedev (Fizicheskiy institut)

TITLE: Ionization of a medium and production of plasma by a laser beam

SOURCE: AN SSSR. Fizicheskiy institut. Trudy, v. 32, 1966. Fizika plazmy (Plasma physics), 89-96

TOPIC TAGS: laser, laser beam, laser ~~beam~~ effect, ionization, medium ionization, plasma production, plasma trapping, *plasma physics*

ABSTRACT: A review is presented of investigations of the use of laser beams for the solution of numerous problems in plasma physics. The review is considered "preliminary," since it deals with a new field. The first section discusses avalanche ionization of a medium by an intense light flash and is concerned with field strengths of  $10^7$  v/cm or over. The second section discusses the diamagnetic perturbation due to ionization of the medium in a beam of intense light, specifically, the possible effects on such plasma by external inhomogeneous magnetic fields. The hot plasma's diamagnetism makes it possible for an inhomogeneous magnetic field to act upon it by accelerating the ionized clouds or throwing it into a trap. A very high field strength  $10^5$  to  $10^6$  oe) applied to small plasma clouds can produce extremely high ejection speeds which can be employed for various plasma and pre-

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ACC NR: AT6033038

thermonuclear processes. The third and fourth sections concern magnetic traps. The advantages of action of intense light upon dense matter placed directly in a magnetic trap are discussed. The steep characteristic of the dependence of ionization rate of rarefied gas on the intensity of light makes it possible, by increased intensity of the light beam (of about 500 Mw), to ionize fast particles (e.g.,  $10^8$  cm/sec) with a probability close to unity. The most advantageous method would be action upon molecular ion beams directed into the trap. The analysis of the processes involved also shows the advantages of using higher harmonics, polarized atoms, and light beams modulated by half the natural frequency of the atoms in the molecule, and by various resonance manipulations of the pumping field.

SUB CODE: 20/ SUBM DATE: none/ ORIG REF: 007/ OTH REF: 006/ ATD PRESS: 5099

Card 2/2 *LC*



ACC. NR: AP7001340

SOURCE CODE: UR/C386/66/004/011/0453/0456

AUTHOR: Askar'yan G. A.; Gol'ts, E. Ya.; Rabinovich, M. S.

ORG: Physics Institute im. P. N. Lebedev, Academy of Sciences SSSR (Fizicheskiy institut Akademii nauk SSSR)

TITLE: Use of artificial meteors for laser pumping

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 4, no. 11, 1966, 453-456

TOPIC TAGS: laser pump, mhd shock wave, mhd generator, ammunition projectile

ABSTRACT: In connection with recently published reports of the use of the energy of an explosion or a flame jet for laser pumping, the authors discuss certain possibilities of using artificial meteors (rapidly moving bodies accelerated by gunshot) to pump medium-power lasers. It is estimated that the energy of a shot from a modern weapon ranges from several kJ (ordinary rifle) to several hundred kJ (cannon) and that at a repetition frequency of 10 - 30 shots per second and an efficiency ~1% this would yield 10 J - 1 kJ. The mechanism of converting the bullet energy into pump energy may be provided either by the flash of light produced by the compression wave in front of the bullet, or by magnetohydrodynamic generation of electric energy by the bullet. In the former case, a bullet maintained at ~3 km/sec over a path length of ~1 m can produce a sufficiently intense pump flash, especially if it moves through a jet of gas having high emissivity. In the mhd case, the electric energy is produced by induc-

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tion as the bullet moves transversely to a strong magnetic field. The necessary conducting circuit is provided by the gas ionized by the moving body. A pulse power of several dozen megawatts can be produced at a velocity of  $\sim 3$  km/sec and a path length  $\sim 30$  cm. It is concluded that the described method can be used to construct compact pump systems for laboratory lasers without resorting to capacitor banks.

SUB CODE: 20/  
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SUBM DATE: 22Aug66/

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